APPENDIX I

Bacteria Loading Analysis

Task Order No. 8—Bacteria Load Allocation

PREPARED FOR: Lower Boise River Water Quality Plan

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DATE: July 15, 1998

Introduction

This technical memorandum (TM) was prepared to partially fulfill the requirements of Task Order 8 under CH2M HILL's contract with the Lower Boise River Water Quality Plan (LBRWQP). The objective of this task was to develop load allocations and wasteload allocations for bacteria for the Lower Boise River watershed. A companion TM has been prepared for sediment allocation.

Background

The Idaho Division of Environmental Quality (DEQ) recommended in its February 24, 1998 document entitled "A Review of Primary and Secondary Contact Recreation Beneficial Uses," that Total Daily Maximum Loads (TMDLs) be developed for bacteria for the main stem Boise River from Star to the Snake River (see Appendix B of DEQ's June 7, 1998 *Draft Subbasin Assessment*). DEQ's evaluation was based on measured exceedances of instantaneous criteria for fecal coliform bacteria.

TMDLs are normally expressed in the form of a Load Capacity (mass or numbers of bacteria per day) based on the critical river flow times the target "concentration" of the pollutant. In the case of bacteria, this target would be numbers of organisms per unit volume water rather than their mass (see Bacteria Sources and Loads TM). The Load Capacity is then apportioned to point sources (wasteload allocations) and non-point sources (load allocations), accounting for background levels and an implicit or explicit margin of safety. A reserve capacity for growth also can be included.

For bacteria, there is some flexibility in how the Load Capacity and allocations get translated into implementation requirements (e.g., NPDES permit limitations), in recognition of the fact that bacteria cannot be expressed as a mass per unit time. This is discussed in more detail later in this memorandum.

Instream Bacteria Targets

The instream targets for bacteria are defined by existing and possible future water quality criteria. The currently promulgated State criteria are based on fecal coliform levels and specific time frames for evaluation (Table 1). The primary contact recreation criteria apply from May through September and the secondary contact recreation criteria are applicable year-round. The primary contact criteria are applicable at all main stem river locations and the secondary contact criteria apply at all main stem locations except from Veteran's Parkway to Caldwell.

TABLE 1
Bacteria Targets

Type	Time Period	Fecal coliforms (CFU/100 mL)	E. coli (CFU/100 mL), [possible future]
Primary Contact (May through September)	May not exceed at any time	500	406
	More than 10% of samples over 30-day period may not exceed	200	NA
	Geometric mean of a minimum of 5 samples in a 30-day period may not exceed	50	126
Secondary Contact Recreation (all year)	May not exceed at any time	800	576
	More than 10% of samples over 30-day period may not exceed	400	NA
	Geometric mean of a minimum of 5 samples in a 30-day period may not exceed	200	126

The State of Idaho is currently conducting a negotiated rule-making process in which a change to E. coli criteria is being considered. Table 1 lists one possible way in which E. coli criteria may ultimately be expressed if adopted.

Seasonal Analyses

Because the applicable targets (i.e., promulgated criteria) already have specifically defined seasonal components of May through September for primary contact recreation and year-round for secondary contact recreation, these are the periods that were used for the bacteria evaluation and allocation.

Description of Available Data

Flows in the tributaries, drains, and main stem river have been recorded historically by a variety of agencies and organizations. Water quality sampling, including fecal coliform bacteria, has also been conducted over time, particularly since 1992 by the U.S. Geological Survey (USGS). USGS has been monitoring levels of fecal coliform bacteria at several locations in the main stem Boise River and at the mouth of most of the tributaries and drains. This work is being conducted under cost-share agreement with the LBRWQP.

Complete descriptions of the hydrology and other physical characteristics of the watershed, including monitoring programs and sources of data, can be found in the *Sediment Load Allocation* TM and DEQ's June 7, 1998 *Draft Subbasin Assessment*.

Existing and Critical Conditions Analysis

Characterization of Existing Conditions

Bacteria levels in the main stem river are shown in Figures 1 and 2 for the primary and secondary seasons, respectively. Table 2 shows the percent reductions in bacteria levels needed to meet geometric mean criteria at each main stem location, based strictly on instream values at those locations (i.e., not a mass balance analysis). Note that the geometric mean values for primary contact recreation are calculated from all data across all years of monitoring in the 1990's, but within that season. The formal geometric mean criteria (Table 1) require at least 5 samples within a 30-day period for compliance evaluation. Because sampling was generally conducted no more frequently than once per month, there are insufficient data available for rigorous comparison with the formal geometric mean criteria. The total number of samples available for the geometric mean calculations is summarized in Table 2 for the main stem stations.

Figure 3 illustrates the geometric mean bacteria levels for each wastewater treatment facility (WWTF) discharging to the main stem and at the mouth of each of the tributaries and drains for which monitoring data are available. Again, these tributary and drain locations have not been sampled frequently enough to meet the minimum criterion of 5 samples within a 30-day period. Figure 4 provides an estimate of the relative inputs of fecal coliform bacteria from point and non-point sources. This chart is based strictly on discharges to the main stem river and does not account for any losses of bacteria from the main stem due to the various diversions.

Given the possibility of a change to E. coli criteria, research was done under this Task Order to determine if a consistent factor or ratio exists that could be used to convert fecal coliform to E. coli data. However, our investigation showed that no such factor exists. Although E. coli is a sub-set of the fecal coliform group, the number of E. coli present will vary depending on the source of the fecal material. The amount of E. coli present will differ if the source is agricultural land, pastureland, or domestic wastewater.

Although a "rule of thumb" may be developed on a site-specific basis, this would require doing a side-by-side analysis. Even then, such a ratio would only provide an idea of the approximate magnitude of the number of E. coli colonies relative to fecal coliforms. It would not be precise enough to determine compliance with a standard.

For example, in "Bacterial Pollution of Waters in Pristine and Agricultural Lands" (Niemi and Niemi, 1991, Journal of Environmental Quality), a comparison is made between fecal coliform bacteria and E. coli. One of the conclusions of that study was that the more pristine the environment, the more closely related are fecal coliform and E. coli analyses.

The State of Colorado undertook a study to develop a ratio of fecal coliform to E. coli (personal communication, Phil Hegeman, Colorado Water Quality Control Division; with Pat Nelson, CH2M HILL, March 4, 1998). The purpose was to develop a ratio so that fecal coliform analysis could be used to determine if E. coli standards for swimming beaches were exceeded. When standards are exceeded, the State health department closes the beaches until levels are acceptable. The results of the study showed that there was too much

Figure 1. Lower Boise River Main Stem
Fecal Coliform Concentrations
May through September (1990 through 1997)

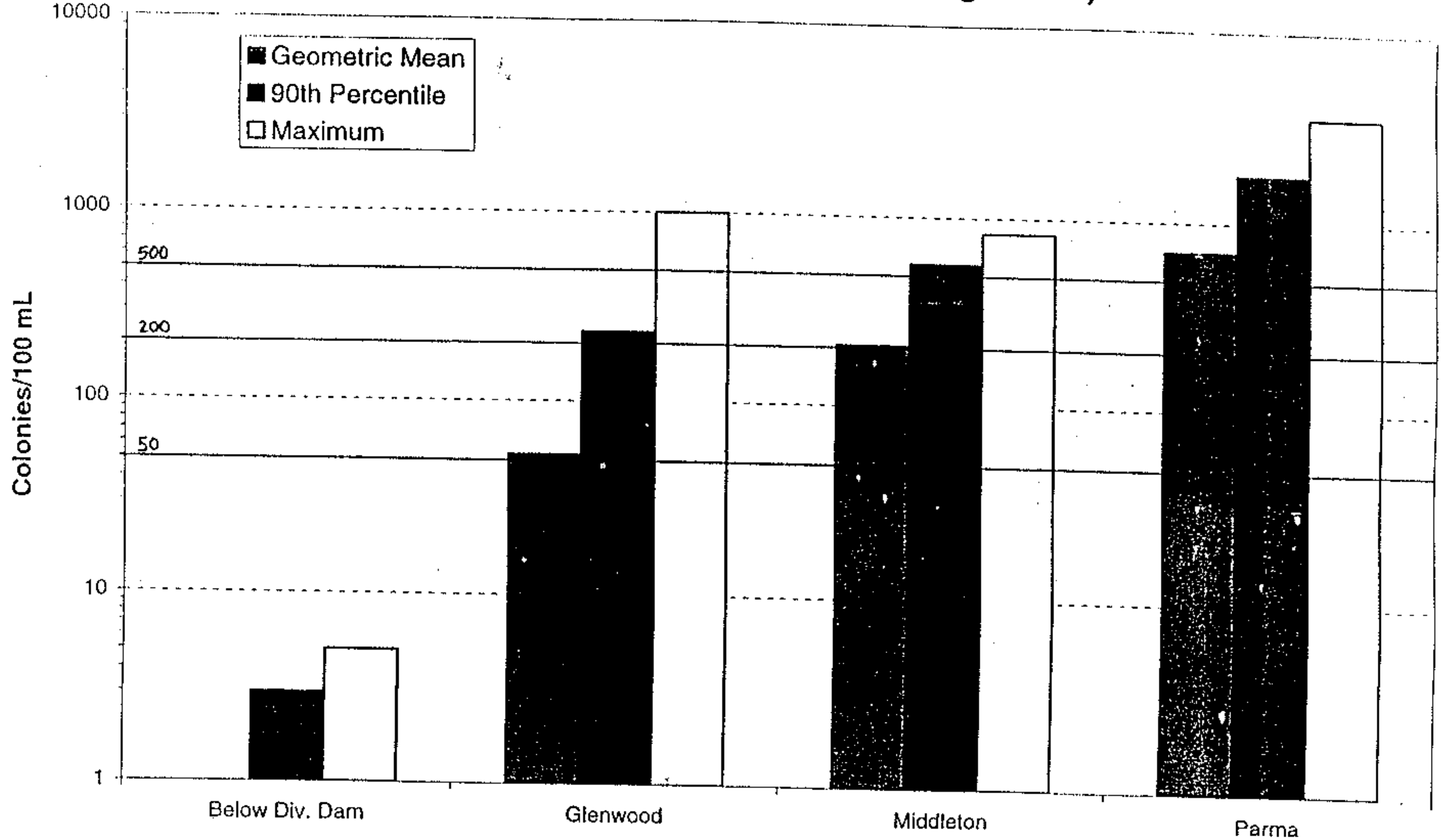
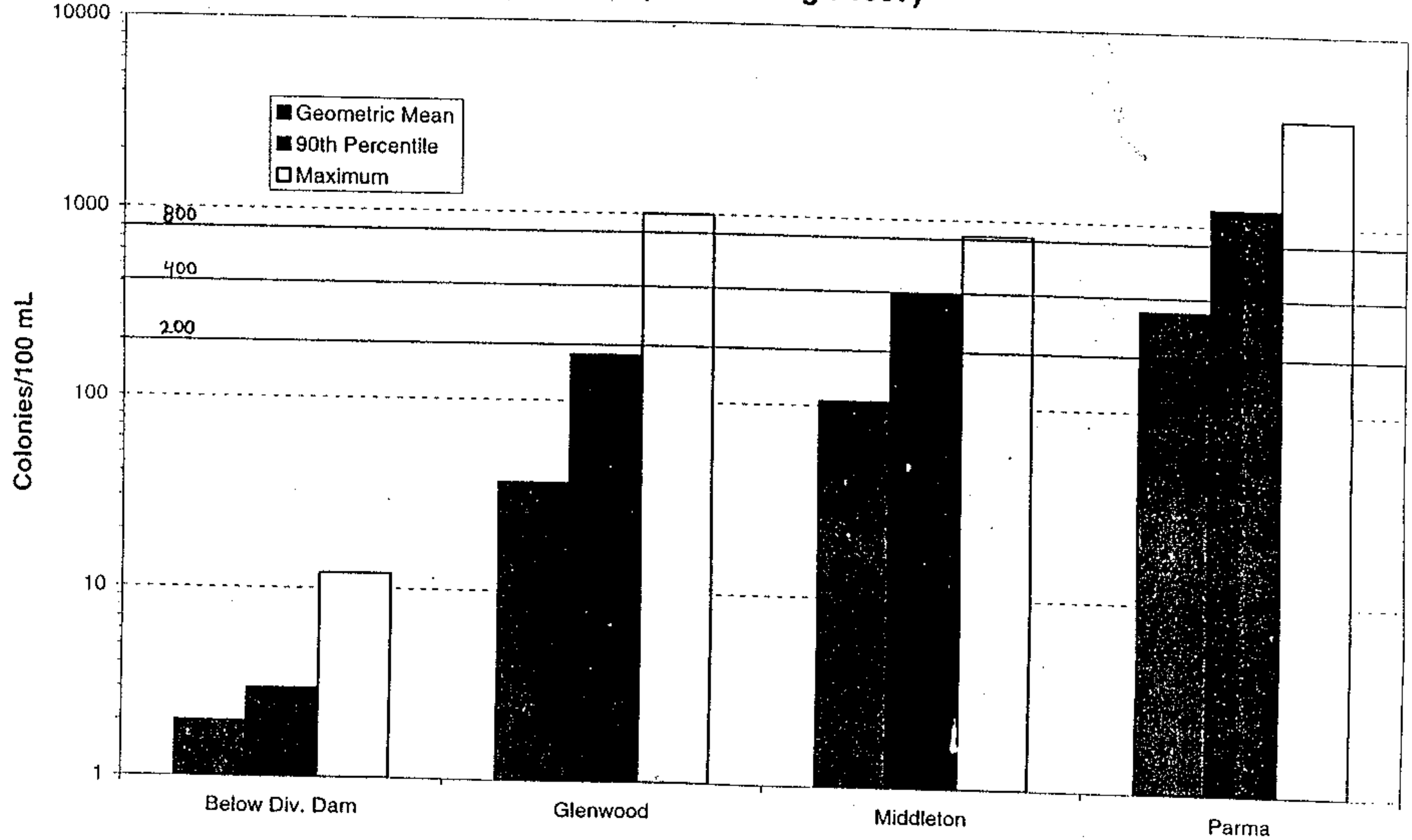


Figure 2. Lower Boise River Main Stem Fecal Coliform Concentrations Annual (1990 through 1997)



p:\137544\fecal\GM_90_Max Chart 4

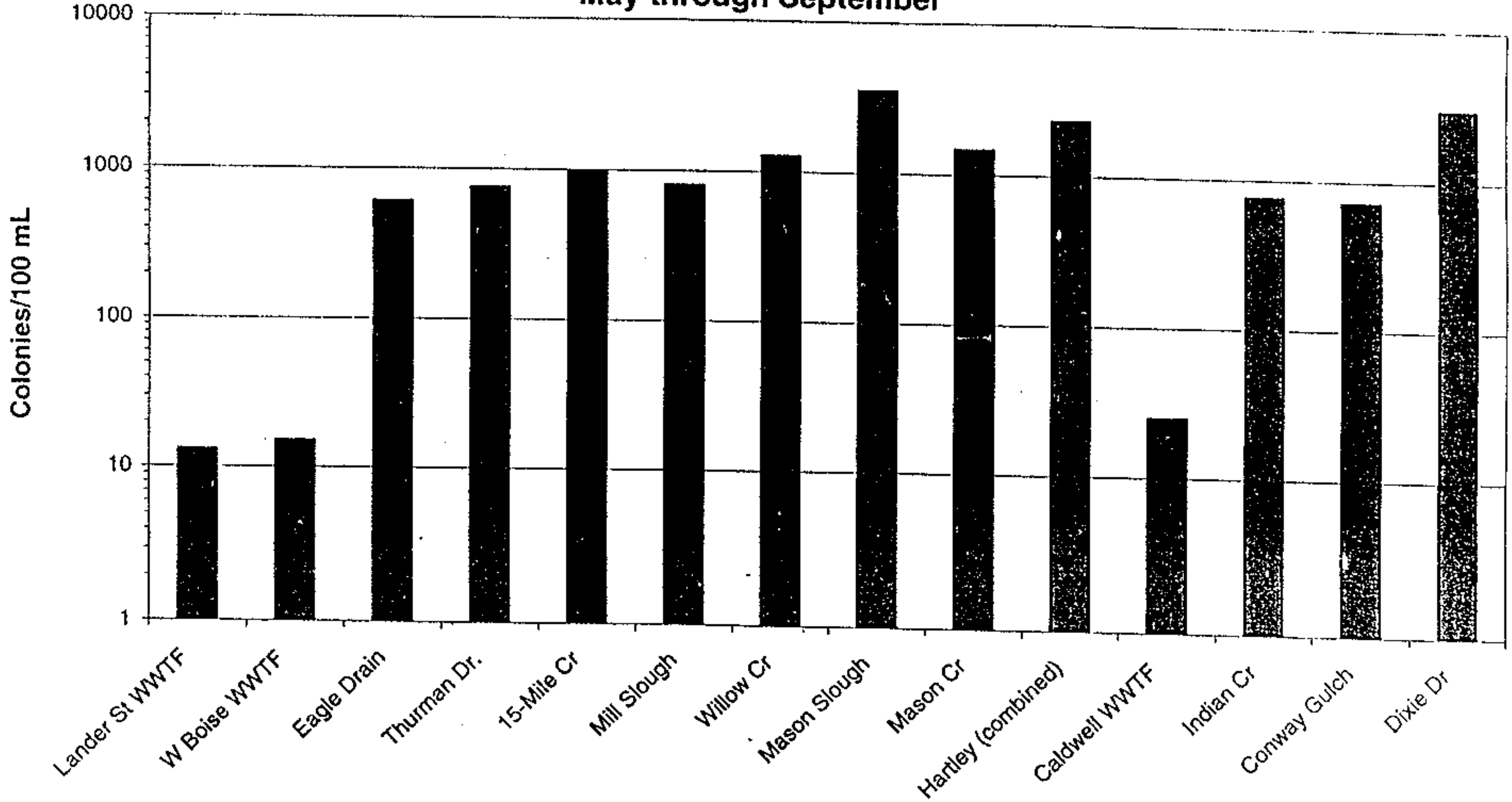
Table 2

Percent Reductions Needed to Meet Criteria Based Only on Concentrations

Boise River	Primary				Secondary			
Stations	Actual (CFU/100 mL)	# samples	Target (CFU/100 mL)	% Red.	Actual (CFU/100 mL)	# samples	Target (CFU/100 mL)	% Red.
Diversion Dam	1	15	50	0%	2	18	200	0%
Glenwood	53	30	50	6%	37	26	200	0%
Middleton	208	15	50	76%	106	16	200	0%
Parma	703	21	50	93%	344	25	200	42%

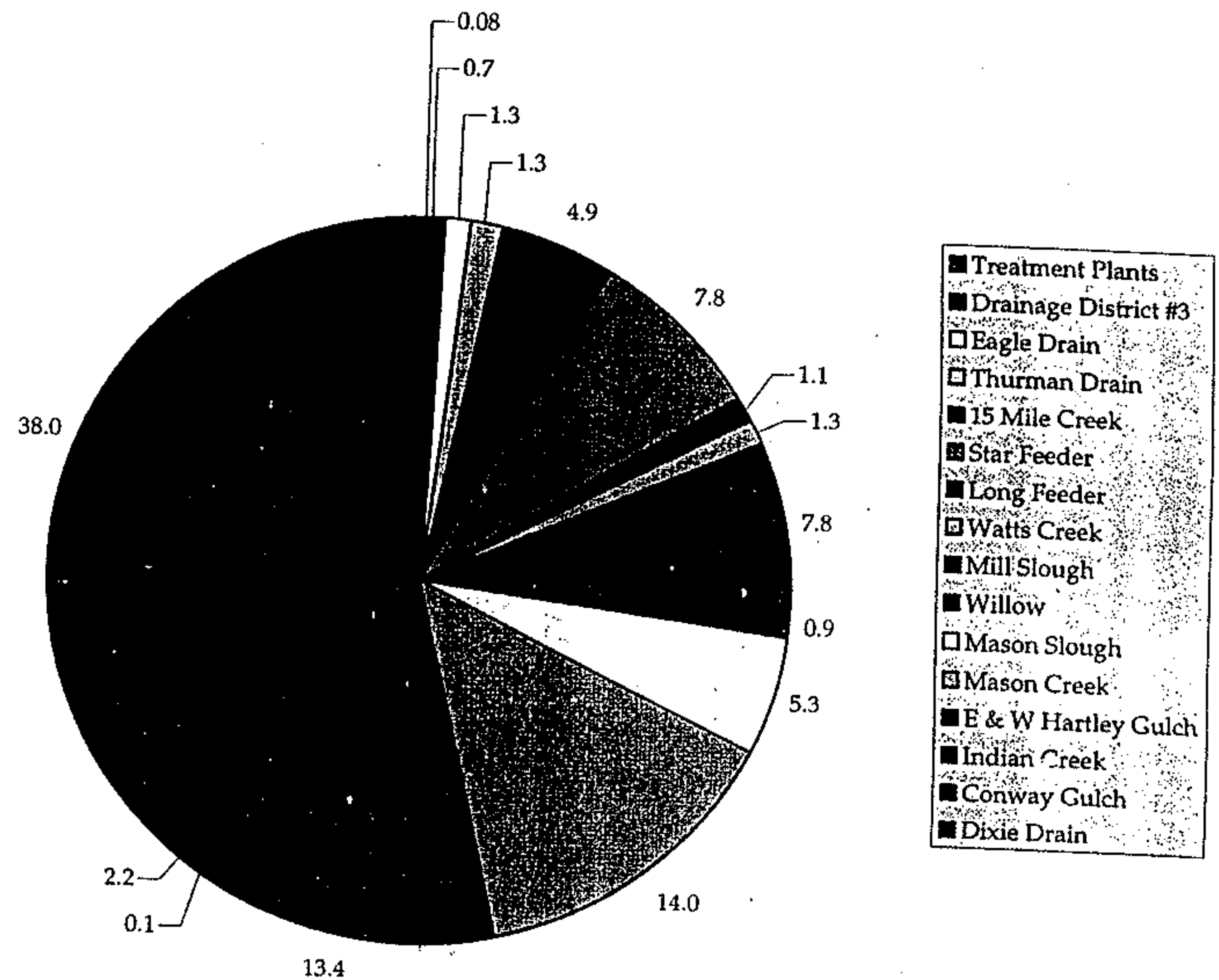
"Actual" is meaured geometric mean value

Figure 3. Lower Boise River Tributary and WWTF Fecal Coliform Geometric Mean Concentrations May through September



Note: Boise WWTF - 1993-96; Caldwell WWTF est.; tribs - 1990-97

Figure 4. 1992 Fecal Coliform Inputs to the Lower Boise River, Percent of CFU/day



variability in the ratio of fecal coliform to E. coli to be used to make such a decision on compliance with the E. coli standards.

A review of the USGS data indicated that results of only three E. coli analyses are available to date for the Lower Boise River. These values are shown in Table 3 obviously are insufficient to allow any conclusions to be drawn.

TABLE 3
E. Coli Results (CFU/100 mL)

Sampling Point	Date of Sample	E. coli	Fecal Coliform	Fecal Streptococcus
Boise River below Diversion Dam	4/14/97	0	1	1
Boise River below Diversion Dam	8/11/97	0	1	1
Indian Creek at Mouth	12/17/96	550	130	NA

NA – Data not available.

Additional discussion of the status of recreation use attainment can be found in DEQ's June 7, 1998 *Draft Subbasin Assessment*.

Mass Balance Considerations

A mass balance for bacteria similar to that developed for sediment (see *Sediment Load Allocation* TM) was attempted for the critical low-flow year of 1992. The balance sheet for the primary contact season is provided in the Appendix. It is clear that the errors in the mass balance are too great to allow for its reasonable use for bacteria evaluation or allocation purposes. The mass balance-derived geometric mean bacteria concentration at Parma for the was 2.7 times higher than the measured geometric mean at that location.

We considered whether incorporation of a bacteria die-off function in the main stem river would be sufficient to correct the mass balance error. The standard first-order decay equation, with a decay rate of 0.02 per hour (at 20°C), was used for this analysis. The decay rate is consistent with that used by Chen and Wells in 1975 for their modeling analysis of the Boise River (TetraTech, Inc.; *Rates, Constants, and Kinetic Formulations for Surface Water Quality Modeling*; 1985). These calculations indicated that about half of the bacteria in the river at Lucky Peak would die off before Parma (roughly a 36 hour travel time), but only one-third of those at Middleton would die off before Parma (roughly a 20 hour travel time). Given that there are significant inputs of bacteria well downstream of Middleton, it is clear that incorporation of die-off alone would not sufficiently correct the mass balance errors.

Critical Flow Conditions

An important consideration in the selection of the critical flow period is whether or not there is a definable relationship between river flow and bacteria levels. Figures 5 through 8 illustrate that there is no discernible relationship at any of the main stem river stations. Consequently, the critical flow should be selected based strictly on flow, without development of a statistical correlation between flow and concentration.

Figure 5. Boise River: Below Diversion Dam
(With all Available Data)

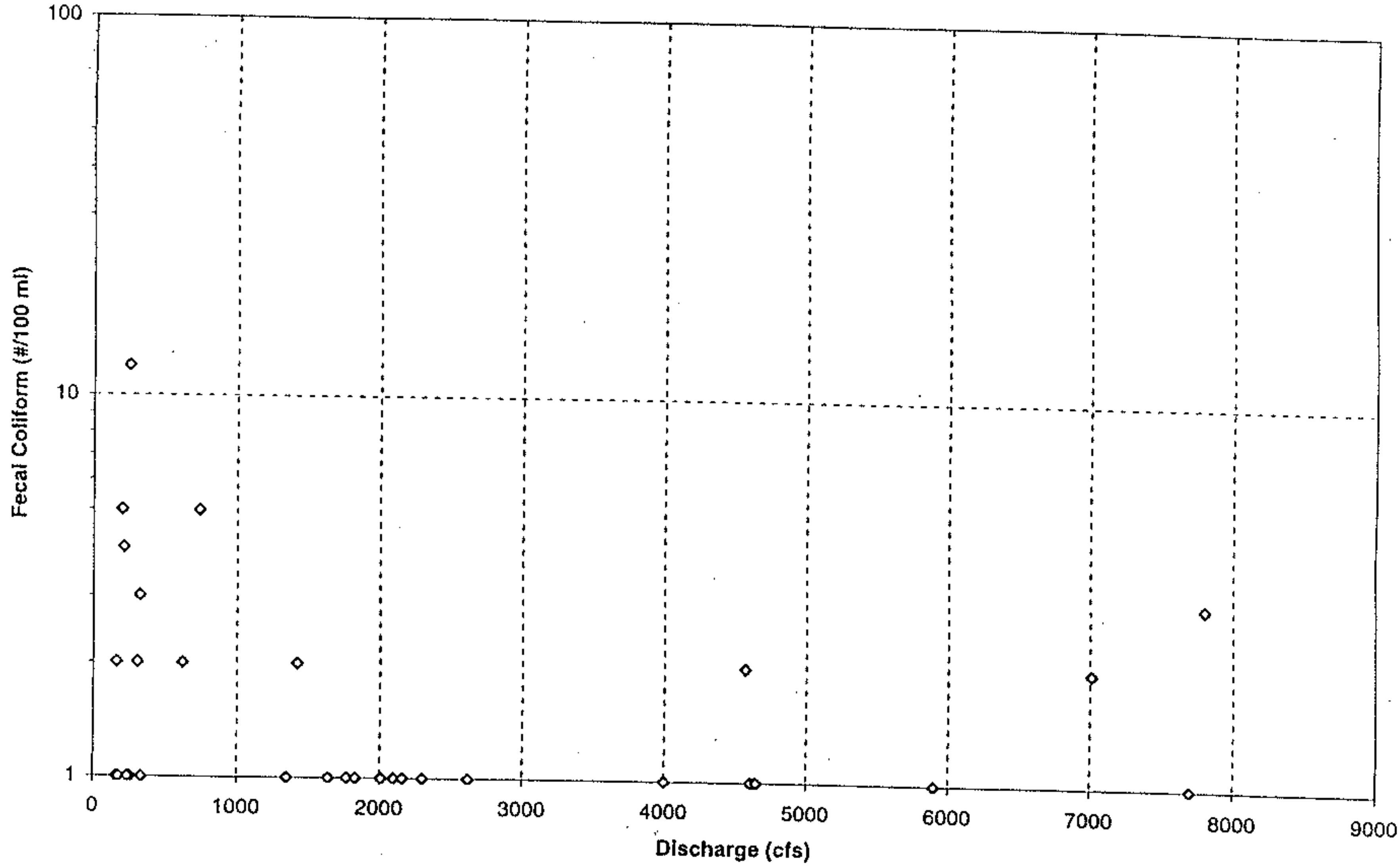


Figure 6. Boise River: Glenwood Bridge
(With all Available Data)

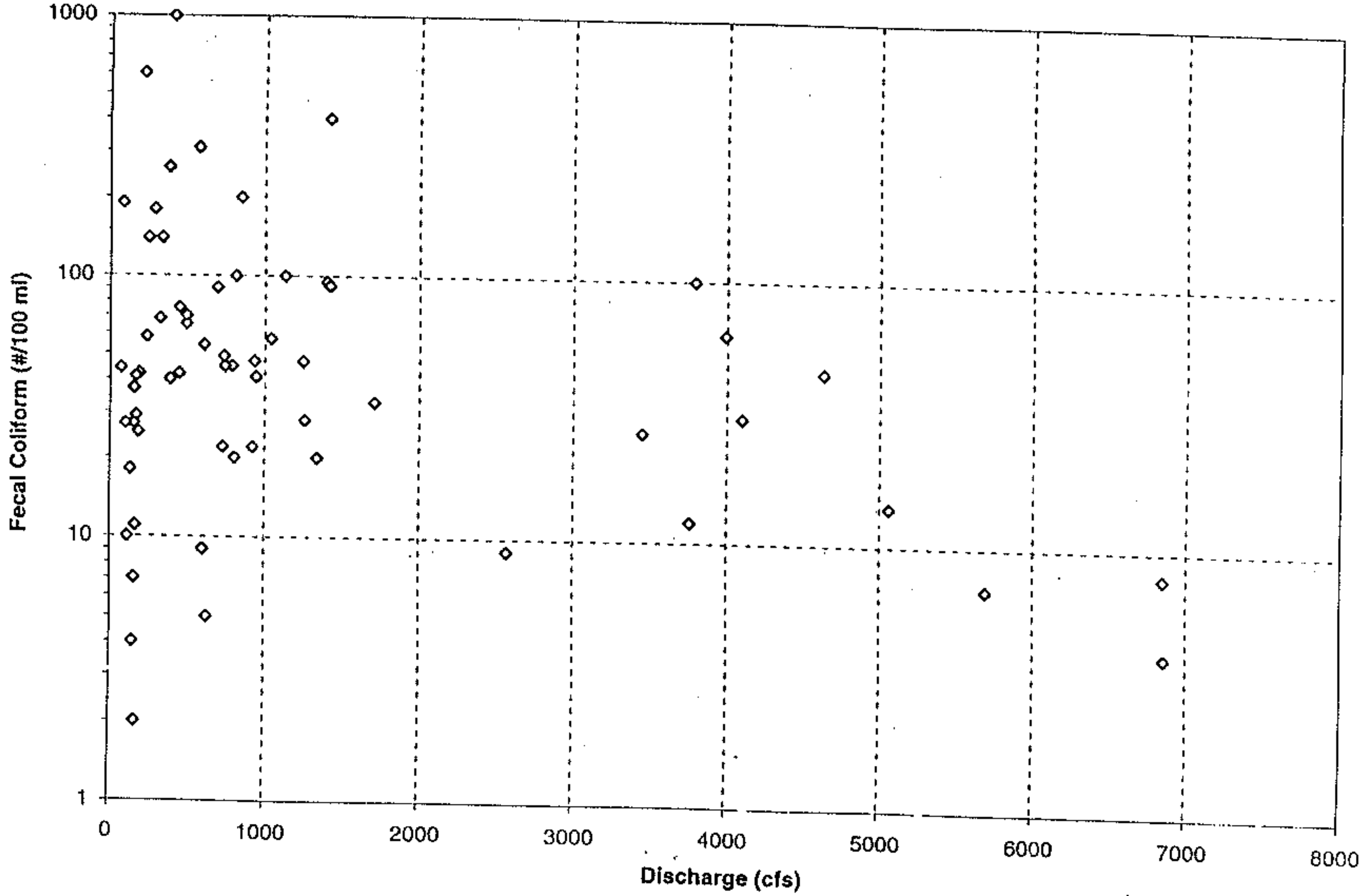


Figure 7. Boise River: Middleton
(With all Available Data)

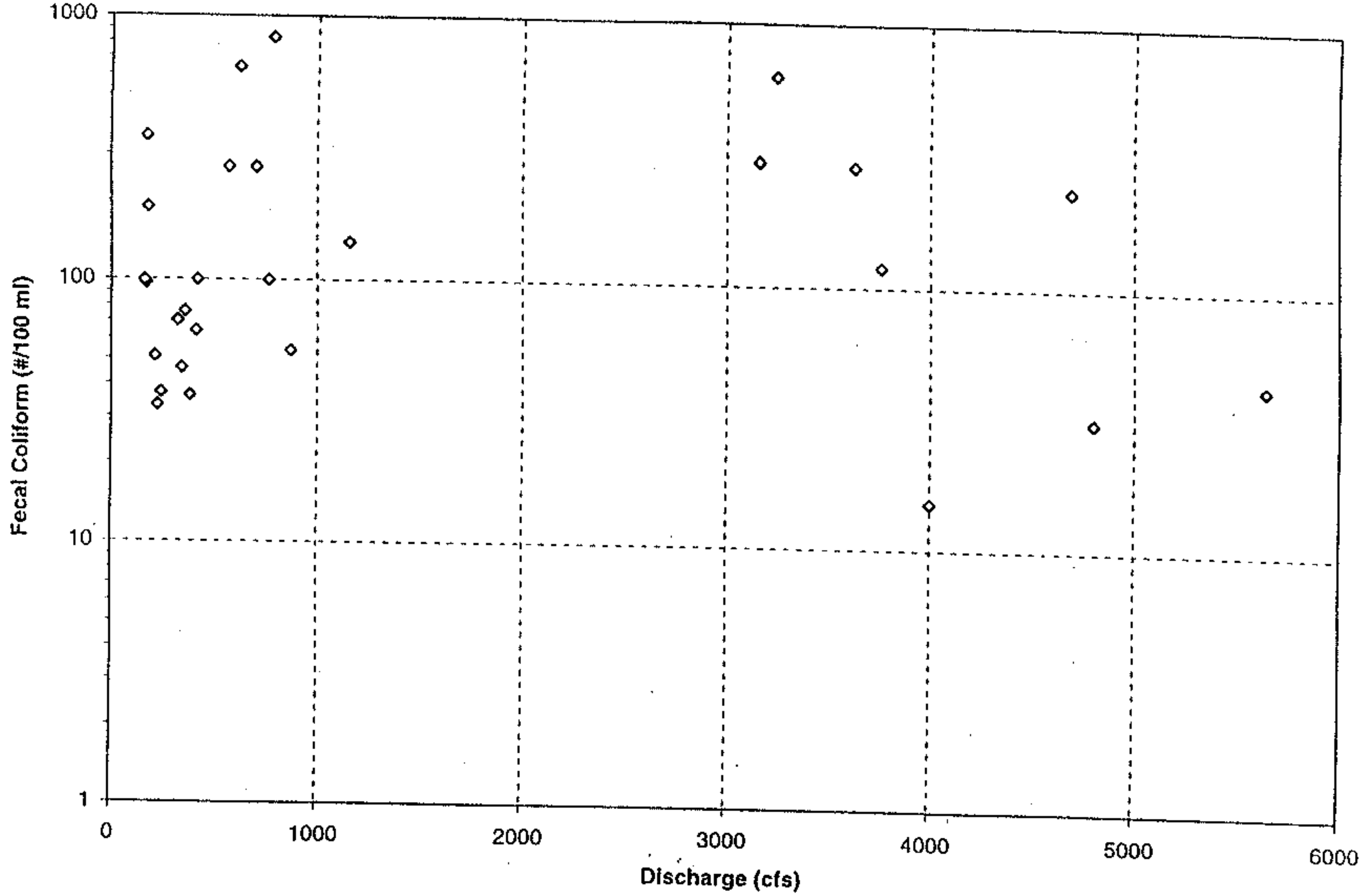
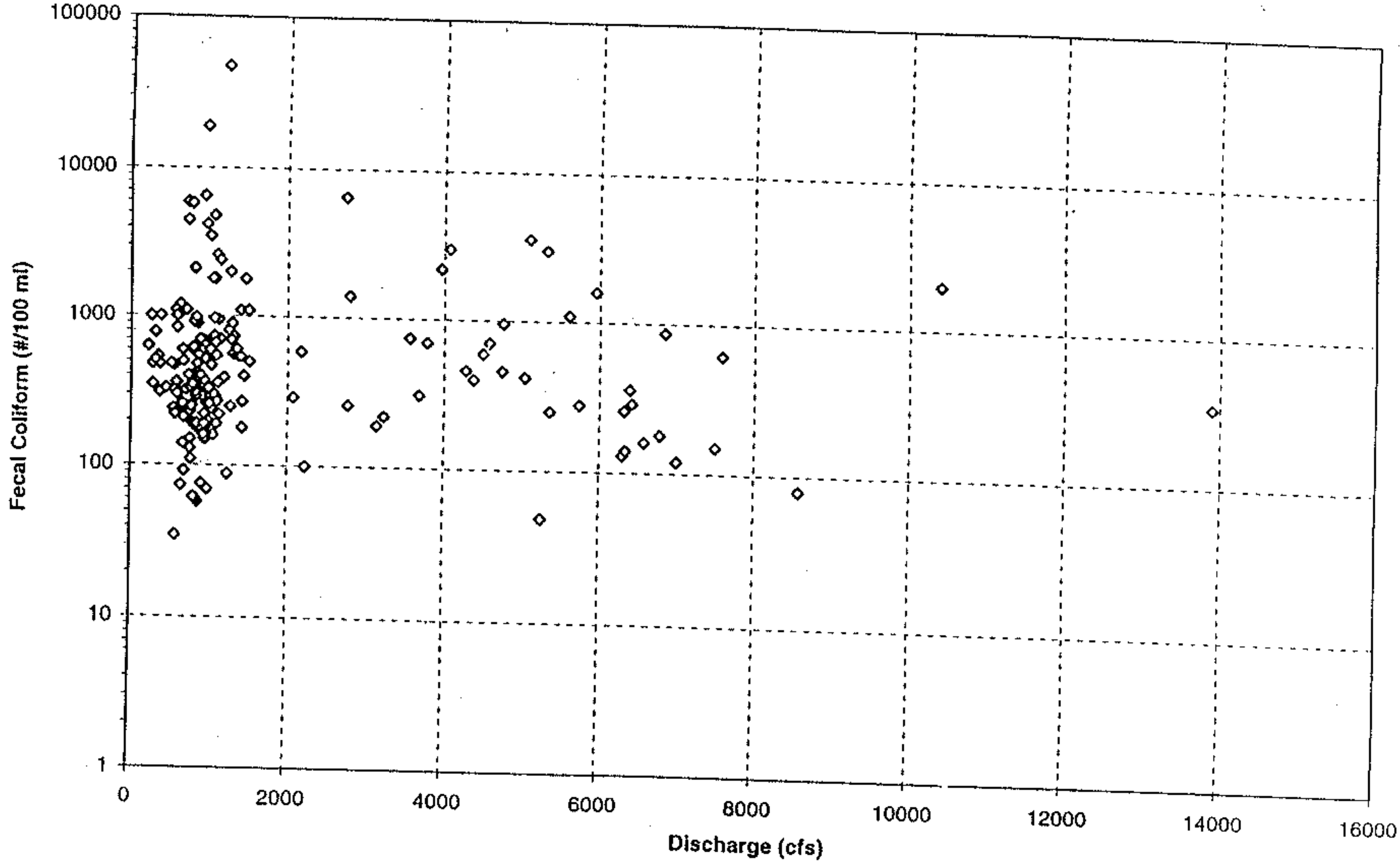


Figure 8. Boise River: Parma
(With all Available Data)



As discussed in more detail in the *Sediment Load Allocation* TM, 1992 was the benchmark driest year since the upstream reservoirs have been in place. Relevant thirty- and seven-day low flows for the applicable seasons are summarized in Table 4. The 10-year flow statistics were calculated by CH2M HILL using EPA's DFLOW program for the period of record shown for each station. It can be seen that the 1992 30-day minimum flows are lower than the 10-year recurrence interval flows at Glenwood and Parma.

TABLE 4
Critical Low Boise River Flows (all values in cfs)

Location	1992 30-day minimum (Primary)	30-day, 10-year (Primary)	7-day, 10-year (Primary)	30-day, 10-year (Annual)
Below Diversion Dam (1986-1994)	NA	417	267	83
Glenwood (1982-1997)	110	331	244	114
Middleton (1974-1997)	151	88	63	90
Parma (1971-1997)	160	295	218	254

Load Capacity Computations at Control Points

Table 5 shows the computed Load Capacities at Glenwood, Middleton, and Parma using the 1992 30-day low flows from Table 4. The Load Capacities are based on the 30-day geometric mean criteria for fecal coliforms for primary and secondary contact recreation. The same flows are used for both criteria because the secondary criteria apply year round.

TABLE 5
Load Capacity Calculations at Control Points for 1992 30-day Low Flows

	Primary Contact Recreation			Secondary Contact Recreation		
Control Point	Flow (cfs)	Target, CFU/100 mL	Load Capacity, CFU/day	Flow (cfs)	Target CFU/100 mL	Load Capacity, CFU/day
Glenwood	110	50	1.35E+11	110	200	5.38E+11
Middleton	151	50	1.85E+11	151	200	7.39E+11
Parma	160	50	1.96E+11	160	200	7.83E+11

The Load Capacity for any bacteria target varies with river flow at any control point as shown in the equation below:

$$LC = Q * T * UCF$$

Where:

LC = Load Capacity (CFU/day)
Q = River flow (cfs)
T = Bacteria target (CFU/100 mL); as fecal coliform (or E. coli if standards change)
UCF = Unit Conversion Factor = 24.46E+06

Future progress toward meeting the TMDL targets should be based on bacteria concentrations as determined through an ongoing monitoring program. Because the Load Capacity varies with flow, the values listed in Table 5 should not be viewed as fixed values irrespective of river flow.

Wasteload and Load Allocations

Summary of Other Bacteria TMDLs

Several other TMDLs have recently been developed for bacteria. These provide useful insight into the various acceptable ways in which wasteloads and loads can be allocated. These examples include:

- Paradise Creek—developed by Idaho DEQ, approved by EPA (*Water Body Assessment and Total Maximum Daily Load,* DEQ Lewiston Regional Office, December 24, 1997)
- Columbia Slough—developed by Oregon DEQ, pending EPA review and approval (*Total Maximum Daily Load (TMDL) for: Chlorophyll a, Dissolved Oxygen, pH, phosphorus, DDE, DDT, PCBs, Pb, fecal coliform and 2,3,7,8 TCDD in the Columbia Slough and phophorus and fecal coliform in Fairview Creek and phosphorus in Fairview Lake,* Oregon DEQ, Draft, January 5, 1998)
- Several lakes in Anchorage—EPA developed (*Total Maximum Daily Load for Fecal Coliform in Lakes Hood and Spenard, Anchorage, Alaska,* EPA Region 10, undated draft; *Total Maximum Daily Load (TMDL) for Fecal Coliform in Jewel Lake, Anchorage, Alaska,* EPA Region 10, undated draft)
- Georgia watersheds—EPA developed (excerpts of the final TMDL for Aycocks Creek watershed provided by Tom McGill, EPA Region 4, faxed to Tom Dupuis, CH2M HILL, May 27, 1998)

Paradise Creek—The Paradise Creek TMDL identified the Moscow WWTP, aquaculture, and non-point sources as sources of bacteria and developed an allocation approach that calls for a 18 percent reduction from the WWTP and a 75 percent reduction from non-point sources. The approach involved use of the geometric mean fecal coliform criterion as the instream target, a flow-variable Load Capacity, a single control point, an implicit margin of safety (recent monitoring data were available), and a lumping of all non-point sources for the load allocation.

Columbia Slough—The Columbia Slough TMDL identified urban storm water, combined sewer overflows (CSOs), and other sources of bacteria. The TMDL did not identify specific percent reductions for each source. The approach involved a flow-variable Load Capacity, best management practices (BMPs) to the maximum extent practicable (MEP) for urban storm water, and near elimination of CSOs from the Slough by the year 2002. There was no margin of safety identified in the TMDL report. The TMDL recommends bacteria management plans and long-term monitoring. Oregon has recently converted to E. coli criteria, and the uncertainties associated with this change factored into the TMDL approach.

Anchorage Lakes—EPA developed bacteria TMDLs for several water supply and recreational lakes in Anchorage. The primary sources of bacteria were geese in the park and beach areas, and for one of the lakes airport storm water runoff was a possible source. EPA targeted a 80 percent reduction in bacteria loading from the geese. The airport was not assigned a percent reduction but a concentration-based wasteload allocation of 18 CFU/100 mL was included in the TMDL. The approach used an organism per day load allocation for two of the lakes in one of the TMDLs and a concentration-only allocation for one of the lakes. The TMDL identified a phased approach to implementation that included activities by the Waterfowl Work Group and monitoring by the airport. A margin of safety of 10 percent was used.

Georgia Watersheds—EPA developed bacteria TMDLs for numerous streams in Georgia impacted strictly by non-point sources. The instream target was the 30-day geometric mean criteria. The load allocation relied on continuous modeling with very limited field data. The allocation strategy included iterative reductions in per acre bacteria loading assumptions until the models indicated that criteria would be met in the stream. Fecal coliform allocations were then set at the model determined numbers per acre per day for land sources. Groundwater and interflow sources were allocated on a concentration-only basis. A margin of safety of 12.5 percent was used in cases where stream flow data were available. Where flow data were not available, a 25 percent margin of safety was used. These margins were deducted from the applicable criterion.

Overall conclusions that can be drawn from the above examples are:

- The use of the 30-day geometric mean criterion is the most common instream target
- Use of flow-variable analysis and Load Capacity definition is common when non-point sources are predominant
- Margins of safety of 10 percent or less (often implicit) are common, especially when flow and/or bacteria data for the watershed are available
- A variety of allocation units can be used, including CFUs/day, concentration-only, and various hybrids of these.

Recommended Lower Boise River Allocation

Margin of Safety

An implicit margin of safety is appropriate for the Lower Boise River TMDL because reasonably extensive and reliable flow and bacteria data are available, the most conservative bacteria criteria (i.e., 30-day geometric mean) are recommended for the instream targets, and the Idaho criterion for primary contact recreation is 4 times more stringent than EPA guidance for fecal coliforms.

Background

The geometric mean background bacteria level at Diversion Dam, the upstream monitoring location in the watershed, is only 1 CFU/100 mL during the primary contact season and 2 CFU/100 mL on an annual basis. Consequently, background levels do not substantively affect allocations or anticipated implementation activities.

Point Source Wasteload Allocation

As required by Idaho regulations, permitted point source dischargers in the watershed must meet applicable bacteria criteria at the end-of-pipe (i.e., no dilution is factored into development of the permit limitations). Because it is not practical or even possible to express bacteria limitations on a mass basis, the numeric limits in the permits are expressed as number per 100 mL. It is recommended that this approach be continued for permits issued in the future to comply with the bacteria TMDL. The permits currently in place in the watershed, and the applicable bacteria limitations, are summarized in Table 6.

Note that EPA's limitations in a number of cases are more stringent than the applicable criteria (compare Table 1 to Table 6). For example, the monthly limitation for many of the municipal dischargers during the secondary contact recreation-only time of the year is 100 CFU/100 mL, or twice as stringent as the 30-day criterion for secondary contact recreation. In addition, EPA includes limitations of 100 CFU/100 mL on a weekly basis during the primary contact season for many municipal permits even though there is no corresponding weekly criterion in the State standards.

Reserve for Growth

A set-aside for growth for municipal point sources is not needed for this bacteria TMDL because these dischargers will continue to be required to meet applicable bacteria criteria, or even more stringent limitations if the current permits provide a forecast of the future, at the end-of-pipe. Consequently, increased effluent flow from these dischargers in the future in response to growth in their service areas will not cause standards violations or substantially affect the load allocation for non-point sources.

Non-point Source Load Allocation

The monitoring data collected to date indicate that geometric mean fecal coliform levels at Glenwood Bridge during the primary contact recreation season are about at the instream target value of 50 CFU/100 mL (Figure 1 and Table 2). Thus, there does not appear to be any dilution upstream of the Middleton and Parma control points that could be factored into load allocations downstream of Glenwood. In addition, the geometric mean fecal coliform level at the mouth of each of the tributaries and drains are at least an order of magnitude greater than the main stem target level of 50 CFU/100 mL (Figure 3 and Table 7). As a result, non-point sources should focus TMDL implementation activities on meeting the applicable target concentrations at the mouth of each of the tributaries and drains. Possible percent reductions needed to meet the existing fecal coliform criteria are listed in Table 7.

TABLE 6
Point Source Wasteload Allocations for Bacteria

Point Source	Averaging Period	F. Coliform Limits, CFU/100 mL
Caldwell (existing permit)	Monthly	50
	Weekly	100
Caldwell (draft new permit), (May - September)	Monthly	50
	Weekly	200
	Daily	500
Caldwell (draft new permit), (October - April)	Monthly	200
	Weekly	200
	Daily	800
Wilder	Monthly	100
	Weekly	200
Notus (May - September)	Monthly	50
	Weekly	100
Notus (October - April)	Monthly	100
	Weekly	200
Meridian (discharge to 5-Mile Creek)	Monthly	100
	Weekly	200
	Daily	800
Meridian (discharge to Boise River)	Monthly	50
	Weekly	100
	Daily	500
Nampa (existing permit)	Monthly	200
	Weekly	200
Nampa (draft new permit)	Monthly	200
	Weekly	200
	Daily	800
Star (May - September)	Monthly	50
	Weekly	100
Star (October - April)	Monthly	100
	Weekly	200

TABLE 6
Point Source Wasteload Allocations for Bacteria

Point Source	Averaging Period	F. Coliform Limits, CFU/100 mL
Armour (May - September)	Monthly	50
	Daily	400
Armour (October - April)	Monthly	200
	Daily	400
Boise, Lander St. (existing permit) (April - September)	Monthly	50
	Weekly	100
Boise, Lander St. (existing permit) (October - March)	Monthly	100
	Weekly	200
Boise, W. Boise (existing permit) (April - September)	Monthly	50
	Weekly	100
Boise, W. Boise (existing permit) (October - March)	Monthly	100
	Weekly	200
Boise, Lander St. (draft new permit) (May - September)	Monthly	50
	Weekly	200
	Daily	500
Boise, Lander St. (draft new permit) (October - April)	Monthly	200
	Weekly	400
	Daily	800
Boise, W. Boise (draft new permit) (May - September)	Monthly	50
	Weekly	200
	Daily	500
Boise, W. Boise (draft new permit) (October - April)	Monthly	200
	Weekly	400
	Daily	800
Idaho Fish and Game hatcheries at Nampa and Eagle Island	Not applicable	No limitations

TABLE 6
Point Source Wasteload Allocations for Bacteria

Point Source	Averaging Period	F. Coliform Limits, CFU/100 mL
Middleton (May - September)	Monthly	50
	Weekly	100
Middleton (October - April)	Monthly	100
	Weekly	200

(Source: Existing Boise permits provided by the City of Boise; draft new permits for Caldwell, Nampa, and Boise as public noticed by EPA on June 17, 1998; all others from letter from Nickie Arnold, EPA, Boise; to Steve Miller, CH2M HILL, June 4, 1998)

Table 7
Lower Boise River Tributaries
Percent Reductions Needed to Meet Bacteria Criteria at the Mouth

	Primary Contact (May-Sept)		Secondary Contact (Annual)	
Tributary	Geometric Mean (CFU/100mL)	Required Percent Reduction	Geometric Mean (CFU/100mL)	Required Percent Reduction
Eagle Drain	604	92	579	65
Thurman Dr.	758	93	512	61
15-Mile Cr	992	95	612	67
Mill Slough	803	94	528	62
Willow Cr	1282	96	556	64
Mason Slough	3507	99	1422	86
Mason Cr	1470	97	515	61
Hartley (combined)	2296	98	565	65
Indian Cr	770	94	384	48
Conway Gulch	723	93	177	0
Dixie Dr	2987	98	1156	83

Again, the monitoring program has not collected samples at any of these locations at a frequency that meets the formal requirement for at least 5 samples per month. Thus, the actual reductions needed are uncertain at this time and the values in Table 7 should be viewed as planning level estimates only. Moreover, if the State of Idaho revises the criteria for E. coli, the magnitude of the reductions needed will certainly change, but by how much is also unknown at this time. For illustrative purposes, if Idaho were to adopt EPA's recommended fecal coliform criterion of 200 CFU/100 mL for the 30-day geometric mean for primary contact recreation, the estimated percent reductions needed would range from 67 to 94 percent, depending on the tributary or drain. So in any case, implementation planning should recognize that substantial reductions in bacteria levels will likely be needed to meet existing and future criteria for bacteria, particularly in the most downstream portion of the watershed between Middleton and Parma.

Implementation Framework

Because the overwhelming majority of bacteria in the Boise River apparently derive from non-point sources, it is imperative that a pragmatic framework be established for implementation activities. Additional reductions by municipal WWTFs not only are not feasible but also would not materially affect bacteria levels in the tributaries, drains, or main stem river. The primary origins of bacteria from non-point sources are not well understood at present but may well be further elucidated through DNA fingerprinting of bacteria via a Section 319 grant to the LBRWQP. The likelihood of a criteria change to E. coli lends further uncertainty to this TMDL process. Thus, practical and implementable strategies should be pursued first, relying on cost-effective BMPs for non-point sources. This is not simply a status-quo approach because various programs and activities have recently been initiated or are likely to be instituted over the next several years that should lead to substantial reductions in bacteria in the river compared to historical conditions. These include:

- Urban storm water—EPA's Phase I storm water regulations require that the City of Boise and most categorical industries implement BMPs to the maximum extent practicable, including illicit connection elimination programs, BMPs for new development and significant redevelopment, and development of public education and involvement activities. EPA recently proposed Phase II regulations that will cover municipalities not currently regulated under Phase I. These EPA regulations are mandated by the Clean Water Act and are not voluntary.

- Septic systems—The district health departments currently have a permitting and regulatory program for septic systems in the watershed. Additional sewering to accommodate growth and increased density of development will be addressed by the health departments and other local governments as needed and required by State and local regulations.

- Agricultural sources—As discussed in the *Bacteria Sources and Loads* TM and DEQ's *Draft Subbasin Assessment*, the agricultural community is expected to implement or be subject to additional water pollution control programs. These include permitting of dairies, additional scrutiny and waste management at confined animal feeding operations (CAFOs), and other programs actively administered by various federal, state, and local agencies. Measures that control or eliminate storm water runoff or illicit discharge of concentrated animal wastes, prevent animal access to waterways, result in agronomic application of animal wastes, and minimize erosion of lands on which manure has been applied are likely to most improve the bacterial quality of the Boise River.

An iterative and adaptive approach to the bacteria TMDL is needed to accommodate the key data gaps and future uncertainties (e.g., new E. coli criteria). A dedicated monitoring program will be essential to tracking progress and reformulating implementation strategies as needed. This approach is consistent with the needs in this watershed, but also conforms to recent recommendations made the Federal Advisory Committee on TMDLs, whose recommendations are expected to be incorporated into EPA TMDL regulations in the near future.

Appendix

Mass Balance

1992 Data (Flows)
To Input target concentration goto --> Cell BS1

INPUT:		CHOICES:	
Fecal Concentration Table:	1	(1 = Measured; 2 = Target (see cell BS1))	Measured
Flow Season:	2	(1 = Annual; 2 = May-Sept; 3 = Oct-April)	May-Sept.
Flow Magnitude:	2	(1 = 10% exceeds; 2 = Median; 3 = 90% exceeds; 4 = Mean)	Median
Conc. Season	2	(1 = Annual; 2 = May-Sept; 3 = Oct-April)	May-Sep
Conc. Magnitude:	1	(1 = Geometric Mean; 2 = 90th Percentile)	Geometr

	Tons/day No Reducton	Tons/day with 9999999.0 mg/L	Load Cap. at 50mg/L
Glenwood U.S.		0	[illegible]
Glenwood Control pt.		1	
Middleton U.S.		0	[illegible]
Middleton Control pt.		1	
Parma U.S.		10	[illegible]
Parm Control Pt.		4	

Mainstem Gaging Location	Station No.	Inflow or Outflow -/+	River Mile	Basin	Measured Flow (cfs)	oncentrati ount/100n	Incremental Daily Mass Load terra bact. /day	Incremental Groundwater Flow (cfs)	Groundwater Concentration (count/100ml)	River Flow (cfs)	River Concentration (count/100ml)	River Load terra bact. /day	Percent Reduction
BR Below Diversion Dam	13203510	[illegible]	[illegible]	[illegible]	1210	[illegible]	0.0	[illegible]	0	1210	[illegible]	0	0.0
Ridenbaugh	13203760	-	58.3		-391.0	1	0.0	1	0	820	1	0	
Bubb	13204005	-	57.5		-6.0	1	0.0	1	0	815	1	0	
Meeves	13204020	-	56.8		-0.7	1	0.0	1	0	816	1	0	
Rossi Mill	13204060	-	56.4		-8.0	1	0.0	1	0	811	1	0	
River Run	13204070	-	56.1		-18.0	1	0.0	1	0	794	1	0	
Boise City	13204190	-	56.0		-20.3	1	0.0	1	0	775	1	0	
Boise Water Corp.	200	-	55.9		-2.0	1	0.0	1	0	775	1	0	
Settlers	13205515	-	52.0		-80.7	1	0.0	1	0	695	1	0	
Davis	13205517	-	52.0		-7.0	1	0.0	1	0	689	1	0	
Boise City Parks	13205613	-	51.5		-0.2	1	0.0	1	0	690	1	0	
Drainage District #3*	13205617	+	51.0		4.6	1623	0.2	1	0	696	12	0	0.0
Thurman Mill	13205622	-	51.0		-23.2	12	0.0	1	0	674	12	0	
Farmers Union	13205640	-	50.4		-122.0	12	0.0	1	0	554	12	0	
Lander Street WWTF	1	+	49.9		8.2	13	0.0	1	0	563	12	0	
BR At Glenwood Bridge	13206000	[illegible]	[illegible]	[illegible]	567	53	0.7	[illegible]	0	567	12	0	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	#######	[illegible]	[illegible]	[illegible]	567	53	1	0.0

p:\137544\sedment\8298bshgw junk.xls concentration constant

8/14/98 4:15 PM